Communications on PURE AND APPLIED MATHEMATICS

A JOURNAL ISSUED BIMONTHLY BY
THE COURANT INSTITUTE OF MATHEMATICAL SCIENCES
NEW YORK UNIVERSITY

VOLUME XXIV • 1971

INTERSCIENCE PUBLISHERS
A Division of John Wiley & Sons, New York–London–Sydney–Toronto
All rights reserved
Reproduction in whole or in part permitted for
any purpose of the United States Government

Statement of ownership, management, and circulation (Act of August 12, 1970; Section 3685, Title 39 United States Code).

1. Date of filing: October 22, 1971.
2. Title of Publication: COMMUNICATIONS ON PURE AND APPLIED MATHEMATICS.
3. Frequency of issue: bimonthly.
4. Location of known office of publication: 20th and Northampton Streets, Easton, Pennsylvania 18042.
5. Location of headquarters of general business offices of publisher: 605 Third Avenue, New York, New York 10016.
6. The names and addresses of publisher, editor, and managing editor:
   Publisher: John Wiley & Sons, Inc., 605 Third Avenue, New York, New York 10016.
   Editor: None.
   Managing Editor: Fritz John, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012.
7. Owner: John Wiley and Sons, Inc., 605 Third Avenue, New York, New York 10016.
   The following is a list of stockholders owning or holding 1% or more of John Wiley & Sons, Inc. stock as of September 24, 1971:
   Cynthia W. Darby, Box 651, Bridgehampton, New York 11932; John P. Gilbert, exec. of estate of Julia Wiley Gilbert, c/o Wells Fargo Bank, Trust Division 37165, P.O. Box 3820, San Francisco, California 94120; Edward P. Hamilton, 605 Third Avenue, New York, New York, 10016; W. Bradford Wiley & Francis Lobdell, Trustees, Elizabeth W. Hamilton Trust, 605 Third Avenue, New York, New York 10016; Edward P. Hamilton, Trustee under will of Elizabeth Wiley Hamilton, c/o Gifford, Woody, Carter & Hayes, 1 Wall Street, New York, New York 10005; I. M. Kolthoff, University of Minnesota, School of Chemistry, Minneapolis, Minnesota; Eric S. Proskauer & Charles H. Lieb, Trustees, u/a by Jenny R. Proskauer, 220 Central Park South, New York, New York 10019; Francis Lobdell & William J. Seawright, Trustees, f/b/o Deborah Elizabeth Wiley, c/o John Wiley & Sons, Inc., 605 Third Avenue, New York, New York; Cynthia W. Darby & Julia Gilbert, Trustees, under will of Kate R. Q. Wiley, c/o Gifford, Woody, Carter & Hays, 1 Wall Street, New York, New York; Francis Lobdell & William J. Seawright, Trustees, f/b/o Peter Booth Wiley, c/o John Wiley & Sons, Inc., 605 Third Avenue, New York, New York; Francis Lobdell & William J. Seawright, Trustees, f/b/o William Bradford Wiley II, c/o John Wiley & Sons, Inc., 605 Third Avenue, New York, New York; Edward P. Hamilton & Cynthia Wiley Darby, Trustees under will of William O. Wiley, c/o Gifford, Woody, Carter & Hays, 1 Wall Street, New York, New York; Adele E. Windheim, 8 Dundee Road, Larchmont, New York; Cudd & Company, 1 Chase Manhattan Plaza, New York, New York; Dif & Company, P.O. Box 1447, 135 Devonshire Street, Boston, Massachusetts: W. Bradford Wiley & E. P. Hamilton, Trustees for Edward P. Hamilton Foundation, c/o John Wiley & Sons, Inc., 605 Third Avenue, New York, New York; Pitt & Company, P.O. Box 2444, Church Street Station, New York, New York; Reing & Company, P.O. Box 491, Church Street Station, New York, New York; Shaw & Company, P.O. Box 491, Church Street Station, New York, New York 10015; Sigler & Company, c/o Manufacturers Hanover Trust Company, New York, New York 10015; Trussal & Company, National Bank of Detroit, c/o Trust Department, Detroit, Michigan; Front & Co., Brown Brothers Harriman, 10 P.O. Square, Boston, Massachusetts 02109; Lane & Co., Southern California First National Bank, c/o Trust Department, San Diego, California 92112; Pendiv & Co., Bankers Trust Company, 16 Wall Street, New York, New York 10005.
8. Known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amounts of bonds, mortgages, or other securities: None.
9. Not applicable.
10. Not applicable.
11. Extent and nature of circulation

	Average no. copies each issue during preceding 12 months	Actual no. of copies of single issue nearest to filing date
A. Total no. copies printed (*net press run*)	2000	2000
B. Paid circulation		
1. Sales through dealers and carriers, street vendors and counter sales	—	—
2. Mail subscriptions	1652	1652
C. Total paid circulation	1652	1652
D. Free distribution (*including samples*) by mail, carrier or other means		
1. Samples, complimentary, and other free copies	2	2
2. Copies distributed to newsagents, but not sold	—	—
E. Total distribution (*sum of C and D*)	1654	1654
F. Office use, left-over, unaccounted, spoiled after printing	346	346
G. Total (*sum of E & F-should equal net press run shown in A*)	2000	2000

I certify that the statements made by me above are correct and complete: CHARLES B. STOLL

Communications on
PURE AND APPLIED MATHEMATICS

CONTENTS

Volume XXIV, Nos. 1-6, 1971

Number 1, January

BREZIS, H.: On a Problem of T. Kato 1
LIPSCHUTZ, SEYMOUR and MILLER, CHARLES F., III: Groups with Certain Solvable and Unsolvable Decision Problems 7
HOPPENSTEADT, FRANK: On Quasilinear Parabolic Equations with a Small Parameter 17
TAYLOR, B. A.: Analytically Uniform Spaces of Infinitely Differentiable Functions 39
CAIN, RICHARD N.: The Leray Spectral Sequence of a Mapping for Generalized Cohomology 53
TREVES, FRANÇOIS: A New Method of Proof of the Subelliptic Estimates 71

Number 2, March

WIDLUND, O. B.: On Lax's Theorem on Friedrichs Type Finite Difference Schemes 117
QUINN, BARBARA KEYFITZ: Solutions with Shocks: An Example of an L_1-Contractive Semigroup 125
LAX, PETER D.: Approximation of Measure Preserving Transformations 133
DAVIS, MARTIN: An Explicit Diophantine Definition of the Exponential Function 137
STROOCK, DANIEL W., AND VARADHAN, S. R. S.: Diffusion Processes with Boundary Conditions 147
DEAKIN, A. S.: Uniform Asymptotic Expansions for a Hyperbolic-Boundary Problem 227
BOYLAN, STANLEY L.: Existence and Uniqueness of Solution of Some Function-Space Differential Equations, I 253

Errata

LAX, PETER D., and PHILLIPS, RALPH S.: A Correction to: The Paley-Wiener Theorem for the Radon Transform 279
NIRENBERG, L., and TREVES, J. F.: A Correction to: On Local Solvability of Linear Partial Differential Equations—Part II. Sufficient Conditions 279

NUMBER 3, MAY

KOUTROUFIOTIS, DIMITRI.: Ovaloids Which Are Almost Spheres 289
KERZMAN, NORBERTO.: Hölder and L^p Estimates for Solutions of $\bar{\partial}u = f$ in Strongly Pseudoconvex Domains 301
KUPKA, I. A. K. and OSHER, S. J.: On the Wave Equation in a Multi-Dimensional Corner 381
BREZIS, H., ROSENKRANTZ, W., and SINGER, B.: On a Degenerate Elliptic-Parabolic Equation Occurring in the Theory of Probability 395
ROSEN, LON.: The $(\phi^{2n})_2$ Quantum Field Theory: Higher Order Estimates 417

NUMBER 4, JULY

CONLEY, CHARLES C. and SMOLLER, JOEL A.: Shock Waves as Limits of Progressive Wave Solutions of Higher Order Equations . 459
MORRISON, J. A., PAPANICOLAOU, G. C., and KELLER, J. B.: Mean Power Transmission Through a Slab of Random Medium . . 473
TRETKOFF, MARVIN: Algebraic Extensions of the Field of Rational Functions 491
CALLEGARI, ANDREW J., REISS, EDWARD L., and KELLER, HERBERT B.: Membrane Buckling: A Study of Solution Multiplicity 499
HÖRMANDER, LARS: On the L^2 Continuity of Pseudo-Differential Operators 529
TREVES, FRANÇOIS: Analytic-Hypoelliptic Partial Differential Equations of Principal Type 537
RALSTON, JAMES V.: Trapped Rays in Spherically Symmetric Media and Poles of the Scattering Matrix. 571

NUMBER 5, SEPTEMBER

JOHN, FRITZ: Refined Interior Equations for Thin Elastic Shells . . 583
BERENSTEIN, CARLOS A.: A Uniqueness Theorem for Convolution Operators 617
TREVES, FRANÇOIS: Hypoelliptic Partial Differential Equations of Principal Type. Sufficient Conditions and Necessary Conditions . . 631
HÖRMANDER, LARS: Uniqueness Theorems and Wave Front Sets for Solutions of Linear Differential Equations with Analytic Coefficients . 671
BREZIS, H., ROSENKRANTZ, W., and SINGER, B.: An Extension of Khintchine's Estimate for Large Deviations to a Class of Markov Chains Converging to a Singular Diffusion 705
MOSER, J.: On a Pointwise Estimate for Parabolic Differential Equations 727

NUMBER 6, NOVEMBER

HUIGE, GUSTAVUS E.: Perturbation Theory of Some Spectral Operators 741
RALSTON, JAMES V.: Note on a Paper of Kreiss 759
TARTAKOFF, DAVID S.: On the Regularity of Non-Unique Solutions of Degenerate Elliptic-Parabolic Systems of Partial Differential Equations. 763
BRIGHAM, ROBERT C.: On the Isomorphism Problem for Just-infinite Groups 789
STORK, DANIEL F.: Structure and Applications of Schreier Coset Graphs 797
HOPPENSTEADT, FRANK.: Properties of Solutions of Ordinary Differential Equations with Small Parameters 807
GARABEDIAN, P. R. and KORN, D. G.: Analysis of Transonic Airfoils 841

Author Index 853
Volume Title Page i
Volume Contents iii

AUTHOR INDEX

Volume XXIV, Nos. 1-6, 1971

Berenstein, Carlos A.: A uniqueness theorem for convolution operators, 617

Boylan, Stanley L.: Existence and uniqueness of solution of some function-space differential equations, 1, 253

Brezis, H.: On a problem of T. Kato, 1

——, *Rosenkrantz*, W., and *Singer*, B.: On a degenerate elliptic-parabolic equation occurring in the theory of probability, 395

——, *Rosenkrantz*, W., and *Singer*, B.: An extension of Khintchine's estimate for large deviations to a class of Markov chains converging to a singular diffusion, 705

Brigham, Robert C.: On the isomorphism problem for just-infinite groups, 789

Cain, Richard N.: The Leary spectral sequence of a mapping for generalized cohomology, 53

Callegari, Andrew J., *Reiss*, Edward L., and *Keller*, Herbert B.: Membrane buckling: A study of solution multiplicity, 499

Conley, Charles C. and *Smoller*, Joel A.: Shock waves as limits of progressive wave solutions of higher order equations, 459

Davis, Martin: An explicit Diophantine definition of the exponential function, 137

Deakin, A. S.: Uniform asymptotic expansions for a hyperbolic-boundary problem, 227

Garabedian, P. R. and *Korn*, D. G.: Analysis of transonic airfoils, 841

Hoppensteadt, Frank: On quasilinear parabolic equations with a small parameter, 17

——: Properties of solutions of ordinary differential equations with small parameters, 807

Hörmander, Lars: On the L^2 continuity of pseudo-differential operators, 529

——: Uniqueness theorems and wave front sets for solutions of linear differential equations with analytic coefficients, 671

Huige, Gustavus E.: Perturbation theory of some spectral operators, 741

John, Fritz: Refined interior equations for thin elastic shells, 583

Keller, Herbert B.: see *Callegari*, Andrew J.

Keller, J. B.: see *Morrison*, J. A.

Kerzman, Norberto: Hölder and L^p estimates for solutions of $\bar{\partial} u = f$ in strongly pseudoconvex domains, 301

Korn, D. G.: see *Garabedian*, P. R.

Koutroufiotis, Dimitri: Ovaloids which are almost spheres, 289

Kupka, I. A. K. and *Osher*, S. J.: On the wave equation in a multi-dimensional corner, 381

Lax, Peter D.: Approximation of measure preserving transformations, 133

Lax, Peter D. and *Phillips*, Ralph S.: A correction to: The Paley-Wiener theorem for the Radon transfer, 279

Lipschutz, Seymour and *Miller*, Charles, F., III: Groups with certain solvable and unsolvable decision problems, 7

Miller, Charles F., III: see *Lipschutz*, Seymour

Morrison, J. A., *Papanicolaou*, G. C., and *Keller*, J. B.: Mean power transmission through a slab of random medium, 473

Moser, J.: On a pointwise estimate for parabolic differential equations, 727

Nirenberg, L. and *Treves*, J. F.: A correction to: On local solvability of linear partial differential equations—Part III. Sufficient conditions, 279

Osher, S. J.: see *Kupka*, I. A. K.

Papanicolaou, G. C.: see *Morrison*, J. A.

Phillips, Ralph S.: see *Lax*, Peter, D.

Quinn, Barbara Keyfitz: Solutions with shocks: An example of an L_1-contractive semigroup, 125

Ralston, James V.: Trapped rays in spherical symmetric media and poles of the scattering matrix, 571

——: Note on a paper of Kreiss, 759

Reiss, Edward L.: see *Callegari*, Andrew J.

Rosen, Lon: The $(\phi^{2n})_2$ quantum field theory: Higher order estimates, 417

Rosenkrantz, W.: see *Brezis*, *H.*

Singer, B: see *Brezis*, H.

Smoller, Joel A.: see *Conley*, Charles C.

Stork, Daniel F.: Structure and applications of Schreier coset graphs, 797

Stroock, Daniel W. and *Varadhan*, S. R. S.: Diffusion processes with boundary conditions, 147

Tartakoff, David S.: On the regularity of non-unique solutions of degenerate elliptic-parabolic systems of partial differential equations, 763

Taylor, B. A.: Analytically uniform spaces of infinitely differentiable functions, 39

Tretkoff, Marvin: Algebraic extensions of field of rational functions, 491

Treves, Francois: A new method of proof of the subelliptic estimates, 71

——: Analytic-hypoelliptic partial differential equations of principal type, 537

——: Hypoelliptic partial differential equations of principal type. Sufficient conditions and necessary conditions, 631

Treves, J. F.: see *Nirenberg*, L.

Varadhan, S. R. S.: see *Stroock*, Daniel W.

Widlund, O. B.: On Lax's theorem on Friedrichs type finite difference schemes, 117